

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

**EEE 7236 – POWER ELECTRONICS AND ELECTRICAL
MACHINES**

04 MARCH 2017
09-00 A.M. – 12-00 P.M.
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages including cover page with 4 Questions only.
2. Answer ALL questions. The distributions of the marks for each question are as stated.
3. Please write all your answers in the Answer Booklet provided.

Question 1

- A. Suggest a suitable Power Electronic Device to be used in a DC-DC controlled converter. The specification for the converter is given as:

Input dc voltage: 300 V Output dc voltage: 240 V (max), Maximum output current: 130 A.

The size of the converter is to be kept minimum. Comment on the voltage and current rating of the device as well as its switching frequency.

Restrict your discussion on BJT, MOSFET, IGBT and GTO only.

[8 Marks]

- B. With block diagrams, using power electronic switches, explain the working of the following in brief:

- (a) Electronic tap changer for power transformer [3 Marks]
- (b) Uninterrupted power supply with main line supply as back-up [4 Marks]
- (c) Adjustable speed drive in an air-conditioning system [5 Marks]
- (d) Static slip frequency voltage recovery in a wound rotor induction motor [5 Marks]

Question 2

- (a) Justify the use of higher pulse converter circuits for HVDC power transmission and explain the working of a 12-pulse converter with a schematic diagram. [13 Marks]
- (b) Consider a buck-boost converter that supplies an output power of 100 W at $V_o = 30$ V from 50 V dc source. The switching period is $T = 100 \mu\text{s}$ and the inductor value $L = 800 \mu\text{H}$. Determine the:
- i) duty ratio and load resistance R [2 Marks]
 - ii) max. and min. inductor currents $I_{L\text{max}}$, $I_{L\text{min}}$ [4 Marks]
 - iii) average input current and diode current [3 Marks]
 - iv) value of C so that the output ripple voltage is limited to $0.02V_o$ [3 Marks]

Assume all components used to be ideal.

Question 3

- (a) Two identical 3 phase, 50 Hz, 5 hp (each), 400 V, 6 pole, delta-connected induction motors are running in parallel. The full load efficiency and power factor of each are 0.9 and 0.8 lagging respectively. Compute the full load current drawn by each of them. [2 Marks]

Continued...

- (b) What will happen on the burning of 'c' phase fuse of the input supply? [2 Marks]
- (c) Suggest any method for satisfactory operation of the motors under the condition of 3(b).
Give the complete analysis of the suggested method with any circuit diagram, if needed. [14 Marks]
- (d) A 250 V series motor has $R_a = 0.4 \Omega$ and $R_{sf} = 0.24 \Omega$. It takes 50 A when running at 1000 rpm. Determine the speed at which the motor runs when the series field is shunted by a diverter resistance of 0.24Ω . The torque developed is increased by 50 %. [7 Marks]

Question 4

- (a) A 17 kW, 440 V, 3-ph, 6 pole, 50 Hz induction motor has full load slip of 3%. If the ratio of standstill reactance to resistance per rotor phase is 3, calculate the plugging torque at full load. [6 Marks]
- (b) A 450 W, 250 V, 50 Hz capacitor-start motor has the main and auxiliary winding data at standstill as given below:
 $Z_1 = 6 + j4.94$ for main winding; $Z_2 = 12.66 + j4.66$ for auxiliary winding
Find the value of starting capacitance that will produce the main and auxiliary winding currents in quadrature at starting. [3 Marks]
- (c) Explain the operation of a 3-phase induction motor as a stepper motor. [4 Marks]
- (d) A single-phase induction motor is found to be rotating in the reverse direction. How do you change the speed to forward direction? [2 Marks]
- (e) A 3-phase stepper motor required for one particular application must be capable of stepping in 5° interval, and it must be capable of running at 300 rpm.
- (i) How many poles must this motor have? [1 Mark]
- (ii) How many pulses per second must be applied to the control circuit? [1 Mark]
- (iii) Construct a table showing step size versus number of poles for three-phase and four-phase stepper motors. [3 Marks]
- (f) With suitable diagrams, write short note on the rotor structure of a Brush-Less Direct Current (BLDC) motor. [5 Marks]

End of Paper